

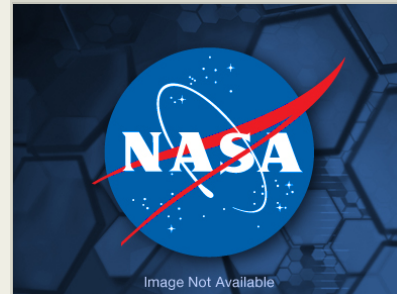
Cosmic X-ray Physics: Sounding rocket investigations of the diffuse X-ray background, including instrument development

Completed Technology Project (2016 - 2019)



Project Introduction

We propose an investigation to improve our understanding of the Galactic diffuse X-ray background. The ultimate purpose of this is to determine the role of hot phases of the interstellar medium in mediating stellar feedback in star formation, in transport of metals, and in determining the structure and evolution of the Galaxy. It directly addresses SMD's astrophysics goal No. 2, to explore the origin and evolution of the galaxies, stars and planets that make up our universe. This work will involve a flight of an existing payload with small modifications in Woomera, South Australia, to observe the Galactic soft X-ray bulge and attempt to determine its nature and emission mechanisms. This flight should also either confirm or put strict upper limits on the "sterile neutrino" model for the 3.5 keV signal observed near the Galactic Center by XMM-Newton. Our investigation includes the development of thermal detectors with superconducting transition edge thermometers capable of 1-2 eV FWHM energy resolution in the 100-400 eV range with the intent of obtaining a scientifically useful spectrum on a sounding rocket flight of the emission from one million degree gas in this energy range. This will require a total area of 1-2 square centimeters for the detector array. To enable routine testing of such detectors in the lab and for necessary in-flight gain and resolution monitoring, we are trying to develop a pulsed-UV laser calibration source. In collaboration with Goddard Space Flight Center, we are investigating the practicality of waveguide-below-cutoff filters to provide the necessary attenuation of infrared radiation for these detectors while still allowing good x-ray transmission below 150 eV. The detectors, calibration source, filters, optimal high-rate pulse analysis and flight experience with the detector readouts are all relevant to future NASA major missions. The detectors we're working on for a low-energy sounding rocket flight would be an excellent match to what is needed for a probe-class mission to map the hot intergalactic medium. If the laser calibration source works well, it would offer huge advantages for a mission like Athena. The metal mesh filters would be particularly valuable in allowing thermal detectors (microcalorimeters) similar to those used here in the X-ray range to be applied to the EUV and vacuum ultraviolet where they offer large potential gains over existing detectors. The ability to analyze overlapping events with minimal loss of resolution could avoid much of the rate/resolution tradeoff of current microcalorimeter data processing schemes. These investigations will provide the primary training for our graduate students, and will involve a substantial number of undergraduates.



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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

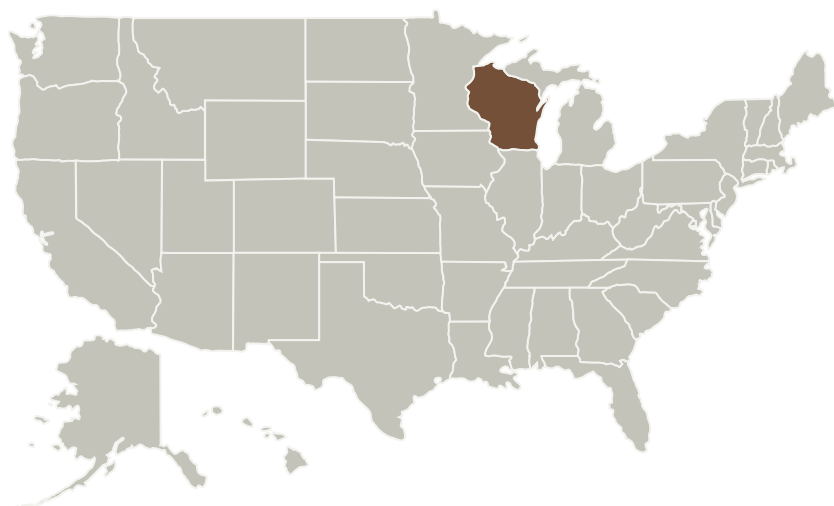
Astrophysics Research and Analysis

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Wisconsin-Madison	Supporting Organization	Academia	Madison, Wisconsin

Primary U.S. Work Locations

Wisconsin

Project Management

Program Director:

Michael A Garcia

Program Manager:

Dominic J Benford

Principal Investigator:

Dan Mccammon

Co-Investigators:

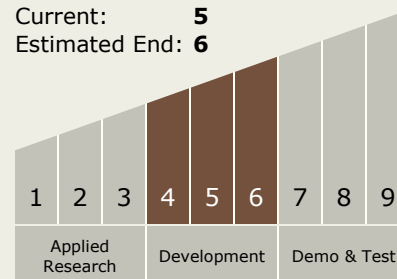
Dallas W Wulf

Felix T Jaeckel

Darlene Holte

Technology Maturity (TRL)

Start: 4
 Current: 5
 Estimated End: 6



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - TX08.2 Observatories
 - TX08.2.1 Mirror Systems

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Target Destination

Outside the Solar System